DECLARATION

I, the undersigned, Tomoko MOKUDAI, residing at 2-45-1-402 Toyoda, Hino-shi, Tokyo, JAPAN, do solemnly and sincerely declare that I well understand the Japanese Language and the English language and that the attached English translation of a certified copy of Japanese Patent Application No. 2000-135224 is true, correct and faithful translation to the best of my knowledge and belief from the Japanese language into the English language.

Dated this 27th day of April, 2004

Tomoko Mokudai

Tomoko MOKUDAI

PATENT OFFICE

JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this Office.

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Applicant:	Tokyo Electron Limited

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[Name of the Document] Specification

[Title of the Invention] Liquid Processing Apparatus

[Claims]

[Claim 1]

A liquid processing apparatus comprising:

processing target holding means for holding a processing target, and capable of rotating the processing target on a plane of the processing target;

processing liquid supply means arranged at a side of one surface of the processing target, for supplying, to the other surface of the processing target, a processing liquid for applying a predetermined process to an edge of the other surface of the processing target, while said processing target holding means is holding and rotating the processing target;

circulation blocking means arranged at a side of the other surface of the processing target, for blocking circulation of the processing liquid supplied by said processing liquid supply means, to a center of the other surface of the processing target.

[Claim 2]

The liquid processing apparatus according to claim 1, wherein said circulation blocking means is constituted by a member arranged adjacent to an either surface of the processing target.

[Claim 3]

The liquid processing apparatus according to claim 1 or 2, wherein said circulation blocking means supplies a fluid to an edge of an either surface of the processing target by ejection.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a liquid processing apparatus, and particularly relates to an apparatus which washes the edge of a plated

substrate.

[0002]

[Prior Art]

A manufacturing process of an electronic device such as a semiconductor, etc. includes a process for forming a thin film on a substrate such as a wafer or the like. For example, manufacture of a semiconductor wafer having a metal wiring includes a process for forming a metal thin film by plating, after forming a seed layer by PVD or the like.

[0003]

Further, in the manufacturing process of a semiconductor device, if a thin film at the edge remains present without being removed, the thin film, at the time of transfer, might be peeled and scattered by contact to the carrier, producing particles which may pollute the carrier and the device.

[0004]

Particularly, in the process for manufacturing a Cu wiring of a semiconductor wafer, the above problem is critical because Cu has a great influence upon Si and SiO_2. As shown in FIG. 7, a Cu seed layer 72 and a Cu plated layer 71 are present at an edge 73 of a wafer immediately after being plated, and the carrier or the like might be polluted by Cu if these unnecessary films are peeled.

[0005]

The above-described pollution of the device due to the thin films peeled from the edge leads to a reduction in the yield of the device, in a trend toward a higher density of devices. Therefore, it is necessary to remove the thin films at the edge by washing (etching) the edge of the substrate.

[0006]

As a washing method for a substrate edge for the above purpose, there is known a method of splashing a resist solvent to the edge of a substrate onto which a resist film is applied, thereby to remove the unnecessary film at the

edge of the substrate. This method is for carrying out a washing process by splashing a resist solvent to the edge from a nozzle or the like from above the surface of the substrate.

[0007]

[Problem to be Solved by the Invention]

However, the above-described method is a method relating to removal of a resist film by a solvent, and can not simply be applied to washing of the edge of a plated substrate on which formed a metal thin film which requires a chemical reaction to be removed.

Further, in a case where this method is used for washing the edge of a plated substrate, there is a problem that the splashed washing liquid and the dissolved material of the thin film scatter onto the surface of the substrate and give an adverse influence onto a device manufacture area. Furthermore, this method can not control the washing width of the edge minutely.

[0008]

Accordingly, an object of the present invention is to provide a liquid processing apparatus which can wash the edge of a substrate without causing an adverse influence to a device, and can control the washing width of the edge of a substrate minutely.

[0009]

[Means for Solving the Problem]

A liquid processing apparatus according to the present invention is characterized by comprising:

processing target holding means for holding a processing target, and capable of rotating the processing target on a plane of the processing target;

processing liquid supply means arranged at a side of one surface of the processing target, for supplying, to the other surface of the processing target, a processing liquid for applying a predetermined process to an edge of the other surface of the processing target, while the processing target holding means is

holding and rotating the processing target;

circulation blocking means arranged at a side of the other surface of the processing target, for blocking circulation of the processing liquid supplied by the processing liquid supply means, to a center of the other surface of the processing target.

[0010]

According to the above-described structure, in washing the edge of a plated substrate, it is possible to process the edge of the plated surface of the substrate by supplying a processing liquid to the edge of the surface of the substrate that is counter to the plated surface and by utilizing the circulation of the processing liquid, and at the same time it is possible to control the quantity of the processing liquid to circulate.

[0011]

In the above-described liquid processing apparatus, the circulation blocking means may be constituted by a member arranged adjacent to an either surface of the processing target substrate.

[0012]

In the above-described liquid processing apparatus, the circulation blocking means may supply a fluid to an edge of an either surface of the processing target by ejection.

[0013]

[Embodiments of the Invention]

(Example 1)

A plating apparatus including a washing apparatus for a semiconductor substrate according to an embodiment of the present invention will now be explained with reference to the drawings.

[0014]

FIG. 1 to FIG. 3 are diagrams showing the entire structure of a plating apparatus 11 including a washing apparatus for a semiconductor substrate

according to the embodiment of the present invention, where FIG. 1 is a three-dimensional cubic diagram, FIG. 2 is a plan view, and FIG. 3 is a side view.

As illustrated, this plating apparatus 11 comprises a cassette station 21 and a processing station 22.

[0015]

The cassette station 21 transfers wafers, which are supplied to the apparatus 11 in the unit of wafer cassette from the outside, from a cassette 23a into the plating apparatus 11, or transfers wafers after being plated, from the plating apparatus 11 out to a cassette 23b.

[0016]

The cassette station 21 is provided with a cassette mounting 24, onto which the wafer cassette 23a storing wafers to be plated is supplied from the outside. Further, on the mounting 24, plated wafers are stored into the cassette 23b for out-transfer.

[0017]

Transfer of wafers on the above-described mounting 24 is conducted by a first transfer mechanism 25. The first transfer mechanism 25 can be moved in an x-axial direction and can be lifted up and down in a z-axial direction so that it can access a plurality of wafer cassettes 23 mounted on the mounting 24. Further, the first transfer mechanism 25 is rotatable around the z axis so that it can transfer wafers from the processing station 22 to the mounting 24.

[0018]

The cassette station 21 and the processing station 22 have the interior atmosphere maintained clean by a down flow of clean air.

[0019]

The processing station 22 has, at predetermined locations, a plurality of plating units 26 for performing plating on a wafer one by one and a plurality of washing/drying units 27 for performing washing and drying after the plating.

[0020]

In the plating units 26, plating is applied to wafers on which a seed layer is formed to form, for example, a Cu thin film on the wafers. In the washing/drying units 27, the front surface, the back surface, and the edge of a plated wafer are washed (etched) with a washing liquid such as a chemical, pure water, etc. and after the washing, the wafer is rotated at high speed under N_2 purge to dry the wafer, as will be described later.

[0021]

As shown in FIG. 2, the processing station 22 is provided with a second transfer mechanism 29 at the center, around which respective processing units are arranged radiately. Further, as shown in FIG. 1 and FIG. 3, the processing station is structured by an upper and a lower two stages. The upper stage and lower stage of the processing station 22 are respectively constituted by four processing units which are arranged radiately around the second transfer mechanism 29, and the processing station 22 thus has eight units.

[0022]

The embodiment shown in FIG. 1 and FIG. 3 illustrates an apparatus structure wherein four plating units 26 are arranged on the lower stage and two washing/drying units 27 and two extra units 28 are arranged on the upper stage.

[0023]

Transfer of wafers inside the processing station 22 is conducted by the second transfer mechanism 29. The second transfer mechanism 29 receives wafers which are transferred by the first transfer unit 25 from the cassette station 21 and then mounted on a mounting 30 in the processing station 22, and transfers them to any of the plating units 26 on the lower stage. After the plating is completed, the second transfer mechanism 29 further transfers the wafers to the washing/drying units 27. Lastly, the second transfer mechanism

29 transfers the wafers which have been through the plating units 26 and washing/drying units 27 to the mounting 30, from which the first transfer mechanism 25 receives the wafers and stores them in a cassette 23. The first transfer mechanism may receive wafers from the washing/drying units directly, not via the mounting 30. In this case, by providing a gate on the side wall between the cassette station 21 and the processing station 22, it is possible to prevent pollution by particles, etc.

[0024]

The second transfer mechanism 29 can be rotated around the z axis and can be lifted upward and downward in the z-axial direction, so that it can access each processing unit in the processing station 22 having the two-stage structure.

[0025]

The second transfer mechanism 29 has three arms, one of which is dedicated to transfer of wafers from the mounting 30 to the plating units 26, another one of which is dedicated to transfer of wafers from the plating units 26 to the washing/drying units 27, and still another one of which is dedicated to transfer from the washing/drying units 27 to the mounting 30 in order to minimize pollution by particles, chemicals, etc.

[0026]

In the above-described embodiment, the apparatus structure is such that four plating units 26 are arranged on the lower stage, and two washing/drying units 27 and two extra units 28 are arranged on the upper stage. However, an apparatus structure wherein the extra units 28 are applied to other purposes is available. For example, a structure is available wherein four plating units 26 are arranged on the lower stage, and one plating unit 26 and three washing/drying units 27 are arranged on the upper stage.

[0027]

Further, the extra unit 28 may be such a processing unit as can be

combined with the plating unit 26 and the washing/drying unit 27, for example an annealing unit for performing annealing after plating.

[0028]

A washing apparatus constituting the washing/drying unit 27 will be explained below. FIG. 4 shows the structure of a washing apparatus according to the present embodiment.

The washing apparatus of the present embodiment is structured such that a generally cylindrical cup 402 whose top surface is opened is provided in a square housing 401 in one side of which an inlet/outlet port 417 for the second transfer mechanism 29 and having a gate valve 416 is formed. This cup 402 can be driven upward and downward by a cup driving unit 403 which is controlled by a control unit 418.

[0029]

The control unit 418 is constituted by an arithmetic processing unit and a ROM or the like storing a processing program, etc., and controls the operation of the entire washing apparatus. Explanation of the functions of the control unit 418 will be omitted, in order to facilitate understanding of the entire apparatus.

[0030]

At the central position of the housing 401, a rotator 404 is provided. The rotator 404 is rotated at a given number of revolutions by the drive of a hollow motor 405 provided outside the housing 401. Above the rotator 404, a rotation table 406 is secured to the rotator 404 with a predetermined interval therebetween.

[0031]

In the interior of a first shaft 407 of the rotator 404, a second shaft 408 is formed. A back surface washing nozzle 409 is secured to the top of the second shaft 408. When a wafer W is held by a holding member, the back surface washing nozzle 409 is present between the wafer W and the rotation

table 406.

[0032]

As shown in FIG. 5, the back surface washing nozzle 409 is structured such that four rod members extend to the edge of the rotation table 406 crosswise from the portion at which the back surface washing nozzle 409 is secured to the second shaft 408. The rod members are hollow interiorly, and communicate with a pipe 410 which passes through the interior of the second shaft 408. Pure water is supplied through this pipe 410 upward from holes 51 which are opened in the upper side of the rod members of the back surface washing nozzle 409.

[0033]

Further, a gas channel 411 is formed in the space between the first shaft 407 and the second shaft 408, and an inert gas, for example, N_2 gas is flowed out from the gas channel 411. The flowed-out inert gas flows to the edge of the rotation table 406 along the surface of the rotation table 406. Accordingly, the rotation table 406 also serves as a gas diffusion plate.

[0034]

Since the inert gas is flowed out from the center of the lower surface of the rotation table 406 outwardly and from the edge of the rotation table 406, i.e., from the edge of a wafer W outwardly during a rotation process, that is, during a time in which the wafer W is subjected to a washing process, it is possible to prevent particles or the like from invading to the back surface of the wafer W. Therefore, the back surface of the wafer W can be prevented from pollution.

An exhaust outlet 412 is provided in the space between the cup 402 and the rotator 404, and exhaust gas and exhaust gas including waste liquid of washing liquid or the like flow in the exhaust outlet 412.

[0035]

As shown in FIG. 5, three holding members 52 are attached to the edge portion of the rotation table 406 by supporting members 53 at an angle of 120°

at regular intervals.

The holding member 52 is a member for holding the wafer W which is transferred into the plating apparatus by the second transfer mechanism 29. As shown in FIGS. 6, the holding member 52 has a structure wherein a holding portion 54 at the upper side and a biasing portion 55 at the lower side are integrated. The holding portion 54 has a step formed at its upper end, whereby the wafer W is held. The holding portion 54 is jointed to the supporting member 53 by a turning fulcrum 56 which is set at an upper end portion of the supporting member 53. The holding member 52 can turn around the turning fulcrum 56. The weight of the biasing portion 55 is set larger than that of the holding portion 54, thereby the biasing portion 55 serves as a plumb bob of the holding member 52.

[0036]

Since the wafer W is rotated at high speed by the rotator 404, the wafer W needs to be held stably. Because of this, the holding member 52 is so structured as not only to hold the wafer W by the step of the holding portion 54 but to hold the edge portion of the wafer W by the biasing of the biasing portion 55.

[0037]

That is, the wafer W, when it is not rotated, is mounted on the holding member 52 and held by the holding portion 54 of the holding member 52. Then, when the rotation table 406 is rotated, the biasing portion 55 tries to move farther outward due to centrifugal force that is exerted on the biasing portion 55, thereby the side of the holding portion 54 of the holding member 52 is pushed toward the center of the rotation table 406, which makes the wafer W be held more firmly.

Further, as illustrated, the holding portion 54 of the holding member 52 is formed to be prominent when seen from the front, and holds the wafer W at the step thereof by point contact.

[0038]

A main washing nozzle 414 is provided above the rotation table 406. The main washing nozzle 414 is connected to a first washing liquid tank 419, and discharges a washing chemical stored in the first washing liquid tank 419 from its nozzle end at a predetermined supply rate. The washing liquid stored in the first washing liquid tank 420 is a mixture liquid of inorganic acid such as hydrofluoric acid, hydrochloric acid, sulfuric acid, etc. or organic acid, and hydrogen peroxide solution (H_2O_2), for example, a mixture liquid of rare hydrofluoric acid and H_2O_2.

[0039]

Further, the main washing nozzle 414 is set such that its nozzle end comes to the center of the wafer W when the wafer W is mounted on the rotation table 406, and is designed to be movable so as not to impede transfer of the wafer W by the second transfer mechanism 29.

[0040]

The second shaft 408 is provided with a circulation blocking plate 415 by an arbitrary support member. As shown in FIG. 5, the circulation blocking plate 415 is provided such that it forms a circle having a radius which is slightly short of the edge of the wafer W.

[0041]

The circulation blocking plate 415 is made of such a material as resin, etc. which is not reactive with rare acid and H_2O_2 which are the washing liquid for plating.

[0042]

As shown in FIG. 7, at the time of washing, the wafer W is mounted in the state that the plated surface directs downward. On the surface of the edge of the wafer W, a Cu seed layer L1 and a copper layer L2 formed thereon by plating are present. The washing (etching) of the edge of the wafer W is carried out by discharging the washing chemical from the main washing nozzle

414 placed above the wafer W and making the discharged washing chemical enter under the lower surface of the wafer W.

[0043]

At the edge of the wafer W, the circulation blocking plate 415 is in a state where it is generally parallel and close to the plate of the wafer W. The gap between the wafer W and the circulation blocking plate 415 is extremely narrow, and the washing liquid receives a force heading to the outside of the wafer W due to rotation of the wafer W. Therefore, of the washing liquid that is supplied from the main washing nozzle placed above and enters under the lower surface, washing liquid which enters the gap between the wafer W and the circulation blocking plate 415 is little in quantity.

[0044]

As described above, circulation of the washing liquid from above the wafer W can be controlled by the circulation blocking plate 415. The difference in position between the end of the circulation blocking plate 415 and the end of the wafer W is the width to be washed due to the circulation of the washing chemical. By adjusting the position of the circulation blocking plate 415, it is possible to obtain a desired washing width, for example, a washing width of around 2 mm at the edge of the wafer W.

[0045]

The main part of the rotary washing apparatus according to the present embodiment is structured as described above, and the washing sequence of the apparatus will be explained below.

The wafer W taken out from the plating unit is transferred by the second transfer mechanism 29 through an inlet/outlet portion 417 of the housing 401 into the washing/drying unit 27 and mounted on the holding members 52 arranged on the edge of the rotation table 406, after which the second transfer mechanism 29 withdraws to the outside of the housing 401 from the inlet/outlet port 417. At this time, the cup 402 is at its lowermost position.

[0046]

After the second washing mechanism 29 retreats, the rotator 404 is rotated by the hollow motor 405, along with which the rotation table 406 is rotated and the wafer W held by the holding members 52 are also rotated. At this time, the cup 402 is lifted to its uppermost position 402' by the cup driving unit 403, in order for the washing liquid or the like not to scatter around in the unit.

[0047]

After the number of rotations of the rotation table 406 reaches a predetermined number of rotations, washing of the back surface and edge of the wafer W is carried out. In washing the back surface and edge of the wafer W, first, pure water is supplied from the back surface washing nozzle 409 to the lower surface of the wafer W. Subsequently, the washing chemical is supplied from the main washing nozzle 414, thereby washing of the lower surface of the wafer W is carried out.

[0048]

After the back surface of the wafer W is washed, spin-drying of the wafer W is performed. The spin-drying is performed for a predetermined time by raising the number of rotations of the rotation table 406 to a predetermined number of rotations and at the same time supplying N_2 from the main washing nozzle 414 above the wafer W and from the holes 51 of the back surface washing nozzle 409 thereunder. At this time, the cup 402 is at a lowered position, so that transfer of the wafer W by the second transfer mechanism 29 is not impeded.

[0049]

After the above-described washing and drying process, the wafer W is transferred to the outside of the washing/drying unit 27 from the inlet/outlet port 417 of the housing 401 by the second transfer mechanism 29.

[0050]

(Example 2)

Another embodiment of the present invention will be explained below, however, explanation of the same part as the example 1 will be omitted.

FIG. 8 shows a washing/drying apparatus according to this embodiment.

In the present embodiment, unlike the example 1, a circulation blocking nozzle is used instead of the circulation blocking plate, in order to control circulation of the washing liquid. A circulation blocking nozzle 421 is directly set to the second shaft.

[0051]

The circulation blocking nozzle 421 is turned toward the edge of the wafer W at an acute angle, and an inert gas such as N_2 gas, etc. or pure water is splashed from the nozzle end. As shown in FIG. 9, circulation of the washing chemical discharged from the main washing nozzle from above the wafer W to under the lower surface of the wafer is controlled by splashing of the pure water or inert gas by the circulation blocking nozzle 421.

[0052]

The supply rate of the pure water or inert gas from the circulation blocking nozzle 421 can be set in accordance with a desired washing width, and the optimum supply rate can be set in association with the optimum nozzle position.

[0053]

The sequence for washing the wafer W according to the present embodiment is the same as the above-described embodiment, and the back surface and edge of the wafer W are washed at the same time.

[0054]

Further, other than the above-described embodiment, as shown in FIG. 10, the wafer W may be mounted with its front end being orientated upward, and the washing chemical may be splashed to the wafer edge from the back surface washing nozzle 409 provided under or an edge supply nozzle 423 provided separately from the nozzle 409 while pure water or an inert gas is

splashed from a circulation blocking nozzle 422 which is provided above the wafer separately from the main washing nozzle 414, thereby the washing chemical circulating to the upper side of the edge of the wafer W may be controlled.

[0055]

In the washing sequence of this case, pure water or an inert gas is first discharged from the circulation blocking nozzle 422 above the wafer W being rotated, and then the washing chemical is supplied from the back surface washing nozzle 409 or the edge washing nozzle 423 to the lower surface of the wafer W, thereby washing of the back surface and edge of the wafer W is carried out.

[0056]

Subsequently, washing of the upper surface of the wafer W is carried out by discharging pure water from the main washing nozzle 414 provided above while maintaining the same number of rotations. After the upper surface of the wafer W is washed, drying of the wafer is carried out by supplying N_2 gas from the main washing nozzle 414 and from the back surface washing nozzle 409 and by rotating the wafer at high speed.

[0057]

In the above-described embodiment, the washing chemical splashed from the main washing nozzle 414 is a mixture liquid of rare hydrofluoric acid and H_2O_2. However, rare hydrofluoric acid and H_2O_2 may be supplied from different tanks storing them separately, and may be mixed immediately in front of the edge washing nozzle 411.

[0058]

Further, the circulation blocking plate 415 of the example 1 or the circulation blocking nozzle 421 and edge washing nozzle 423 of the example 2 may be arranged in a plural number on the edge of the wafer W, in order to wash the edge of the wafer W.

[0059]

In the above-described embodiment of the present invention, there has been explained a case where a semiconductor wafer is subjected to liquid processing. However, the liquid processing apparatus of the present invention can be applied to processing of a glass substrate or the like for an LCD, in addition to a semiconductor wafer as a processing target.

[0060]

[Effects of the Invention]

As explained above, according to the present invention, there is provided a liquid processing apparatus which can wash the edge of a substrate without giving an adverse influence on a device and can minutely control the washing width of the edge of a substrate. Further, according to the present invention, there is provided a liquid processing apparatus for the edge of a plated substrate, making it possible to restrict generation of particles peeled from the wafer edge and to obtain a wider device area by minutely control the washing width.

[Brief Description of the Drawings]

[FIG. 1]

FIG. 1 is a schematic cubic diagram showing the entire structure of a plating apparatus according to an embodiment of the present invention.

[FIG. 2]

FIG. 2 is a schematic plan view showing the entire structure of the plating apparatus according to the embodiment.

[FIG. 3]

FIG. 3 is a schematic side view showing the entire structure of the plating apparatus according to the embodiment.

[FIG. 4]

FIG. 4 is a cross section of a liquid processing apparatus according to the embodiment of the present invention.

[FIG. 5]

FIG. 5 is a top view of a back surface washing nozzle 409 and a circulation blocking plate 415 according to the embodiment.

[FIGS. 6]

FIGS. 6 are a side view and a front view of a holding member 52 for a wafer according to the embodiment.

[FIG. 7]

FIG. 7 is a diagram showing a method of washing the edge of a wafer according to the embodiment.

[FIG. 8]

FIG. 8 is a cross section of a liquid processing apparatus according to the embodiment.

[FIG. 9]

FIG. 9 is a diagram showing a method of washing the edge of a wafer according to the embodiment.

[FIG. 10]

FIG. 10 is a diagram showing a method of washing the edge of a wafer according to the embodiment.

[Explanation of Reference Numerals]

11 plating apparatus

21 cassette station

22 processing station

23 wafer cassette

25 first transfer mechanism

26 plating unit

27 washing/drying unit

28 extra unit

29 second transfer mechanism

402 housing

405 hollow motor

406 rotation table

409 back surface washing nozzle

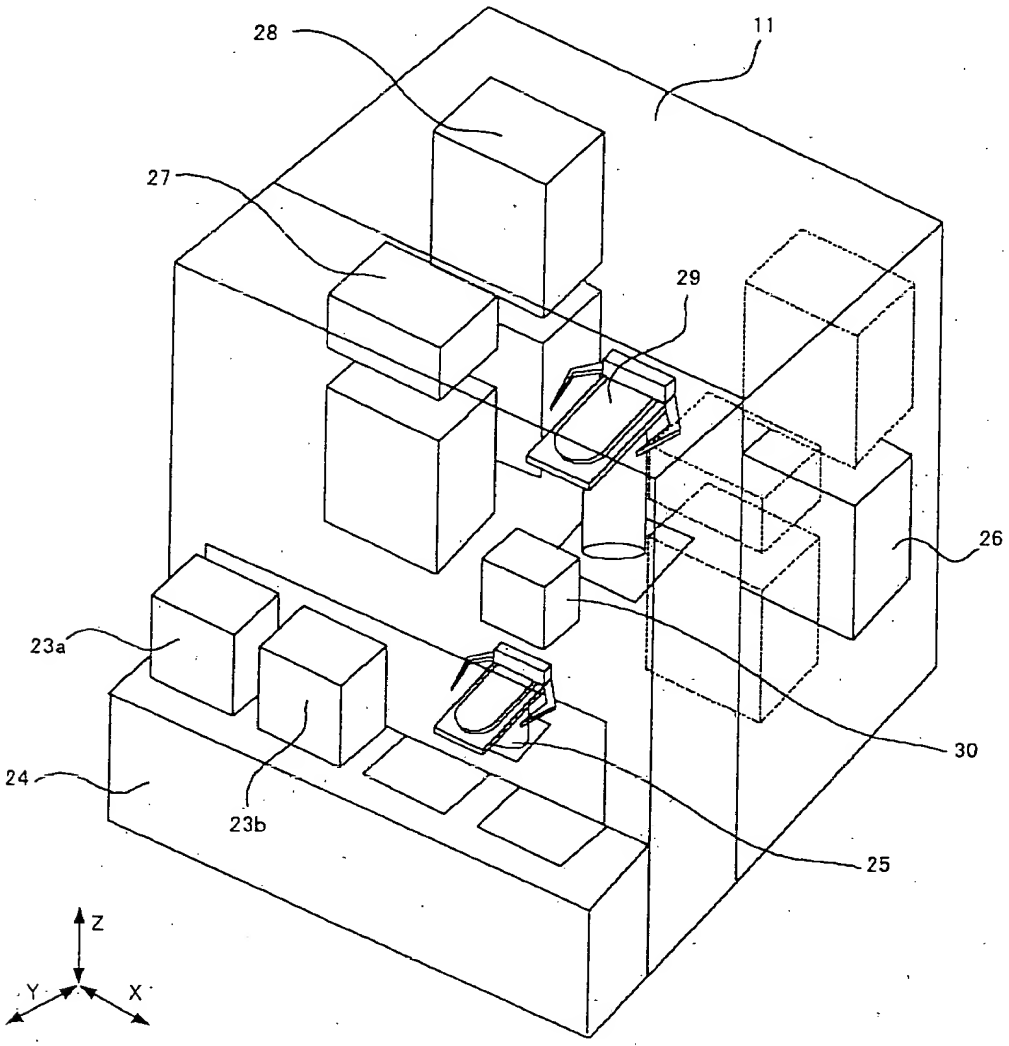
414 main washing nozzle

415 circulation blocking member

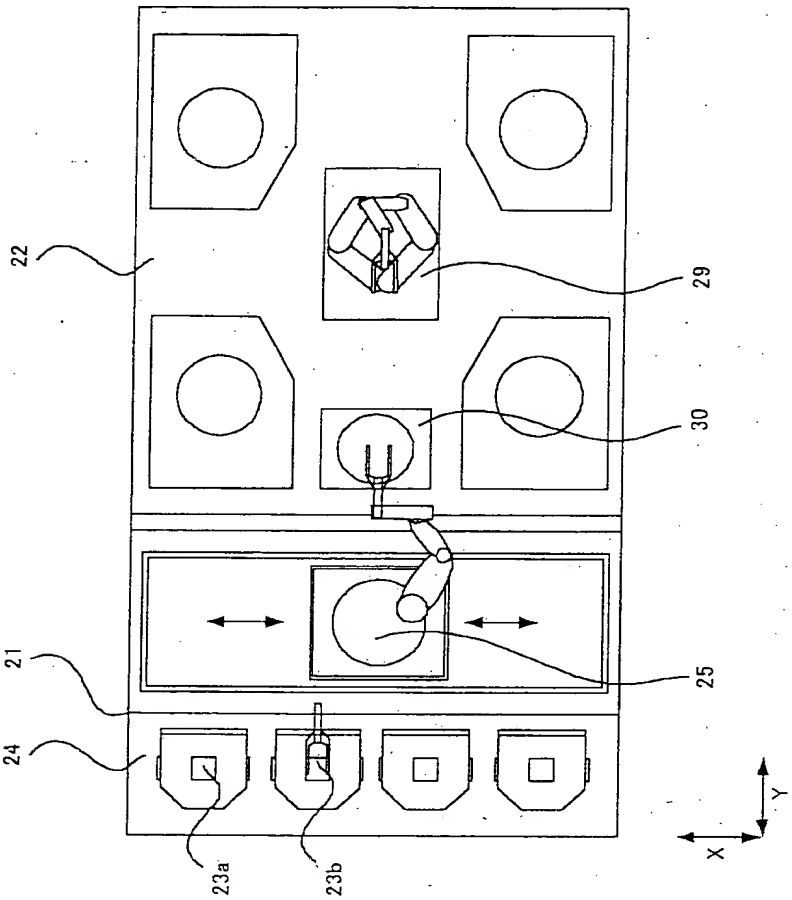
52 holding member

W wafer

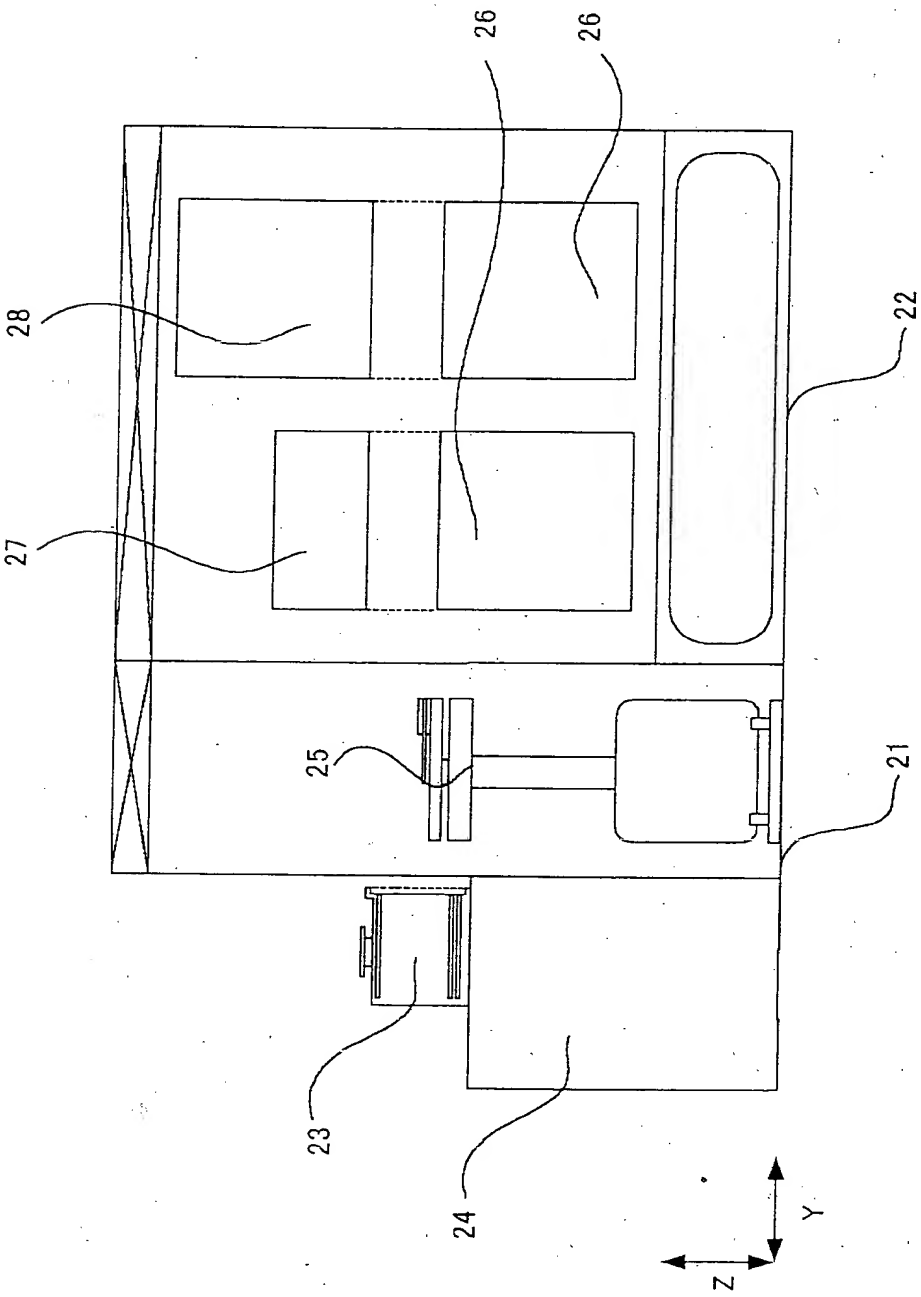
【書類名】　図面
[NAME OF DOCUMENT] DRAWING
【図１】 [FIG. 1]



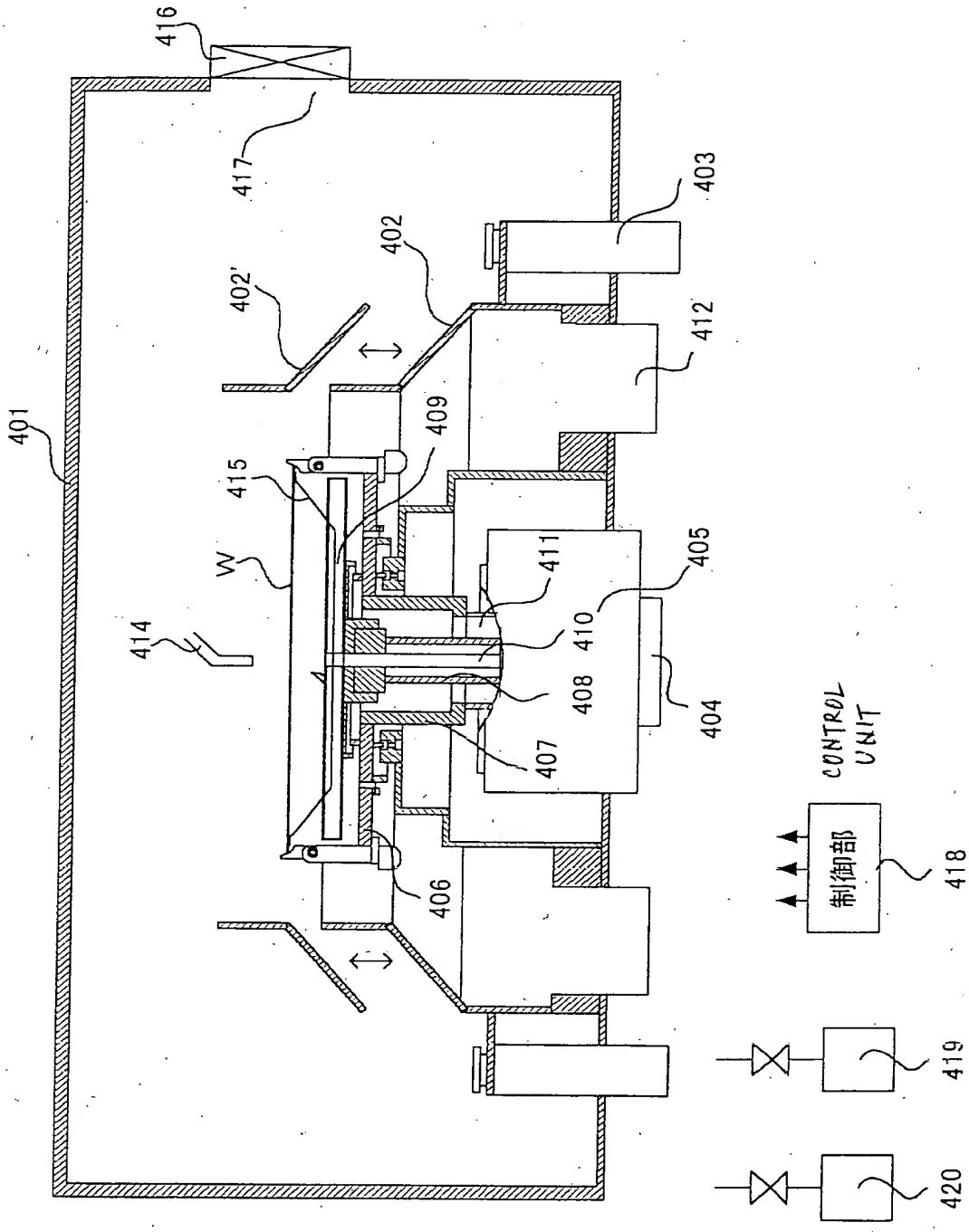
【図２】[FIG.2]



【図３】[FIG. 3]



【図４】[FIG. 4]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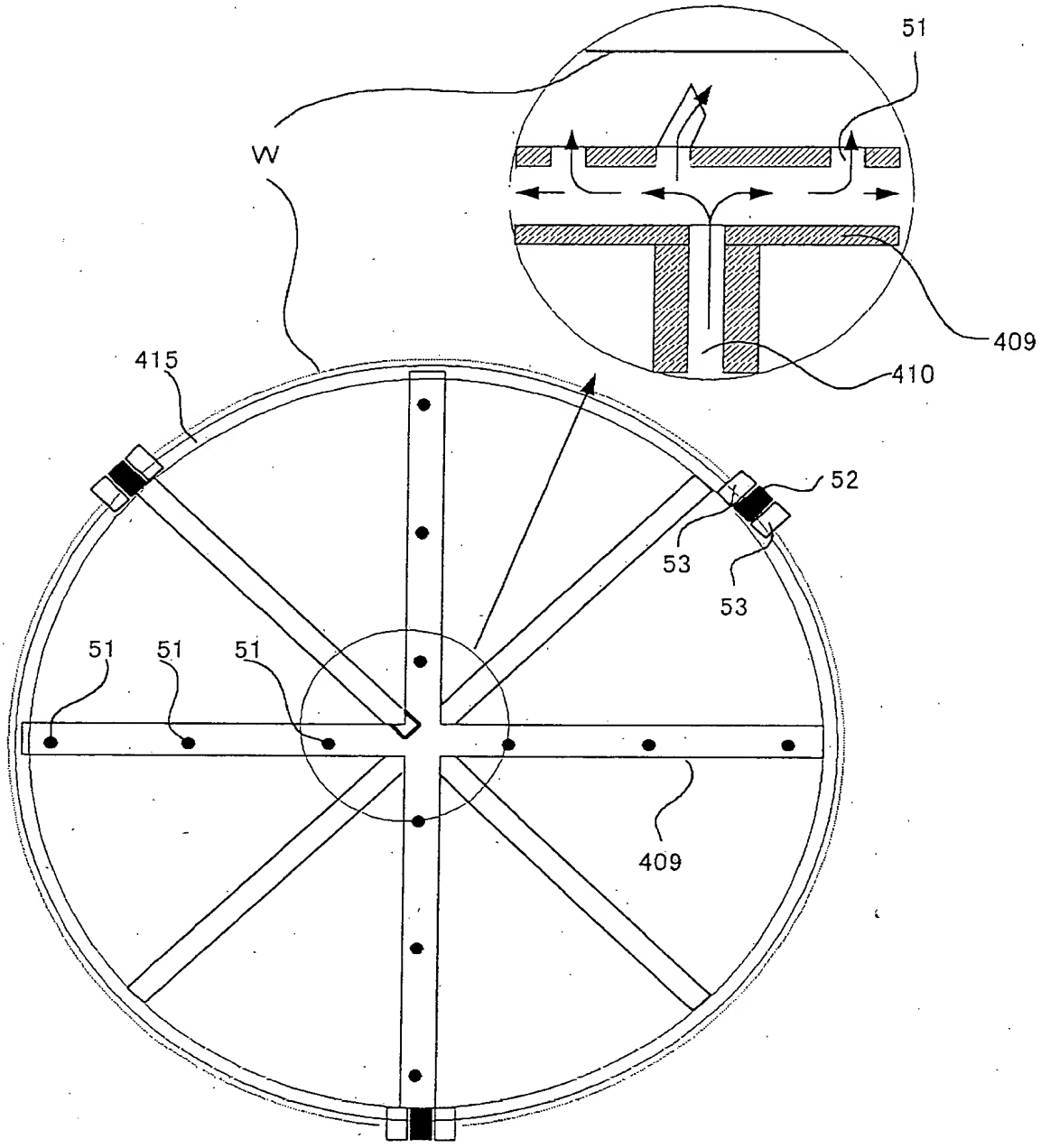
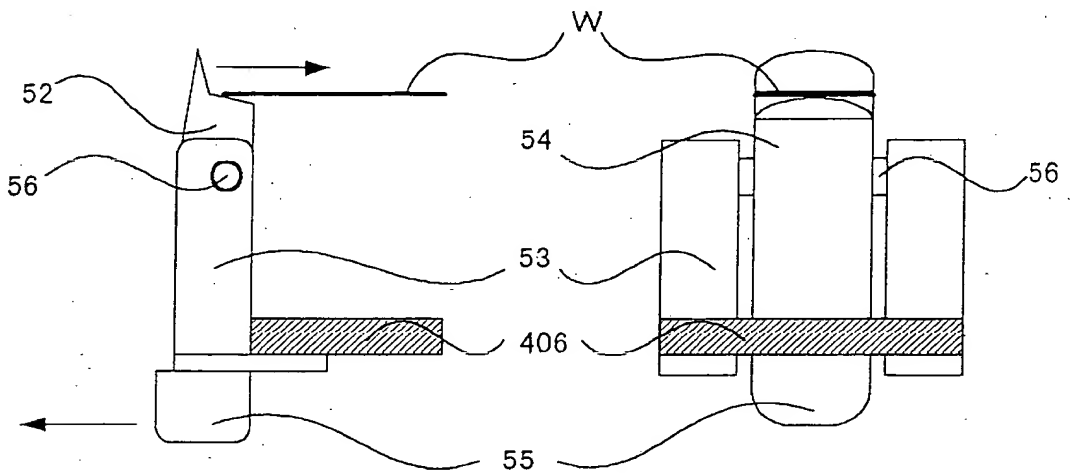
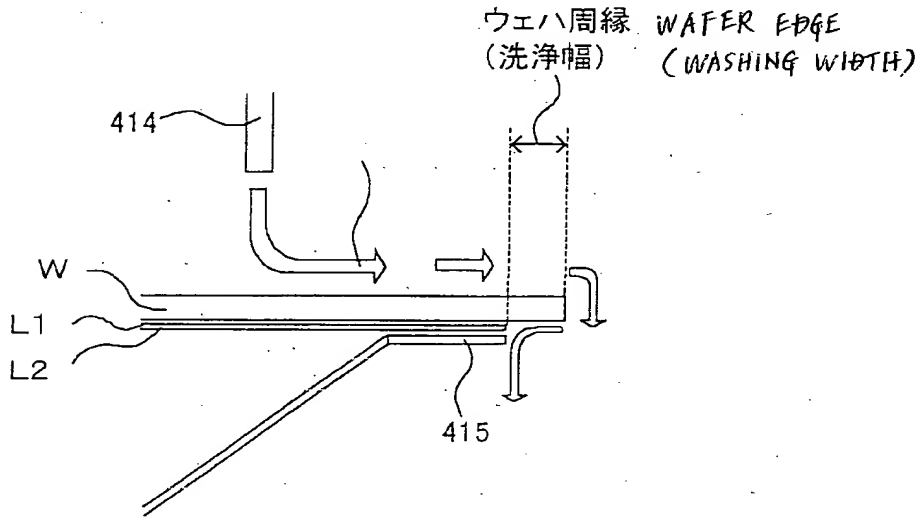
【図５】[FIG.5]



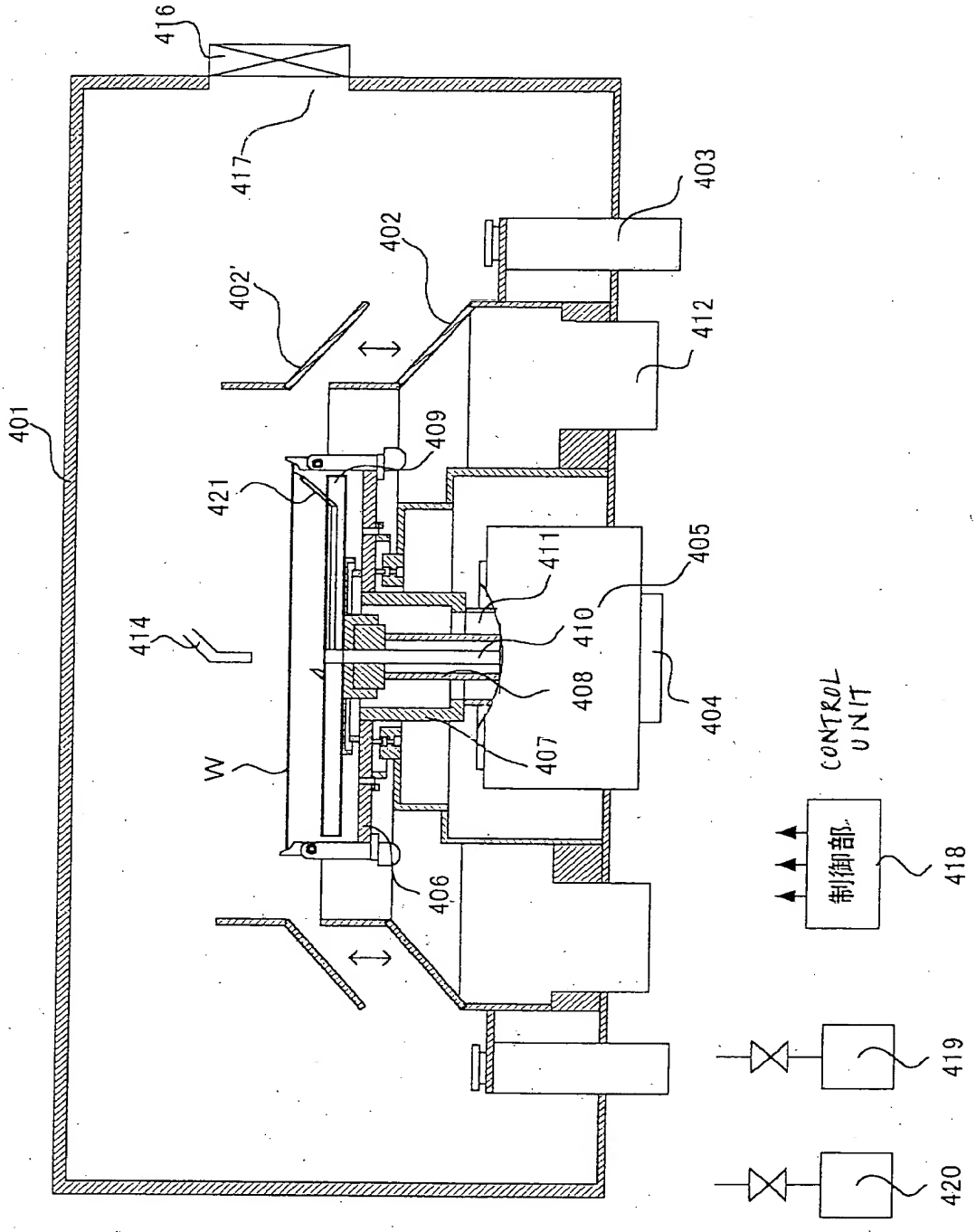
【図６】[FIGS. 6]



【図７】[FIG. 7]



【図８】 [FIG.8]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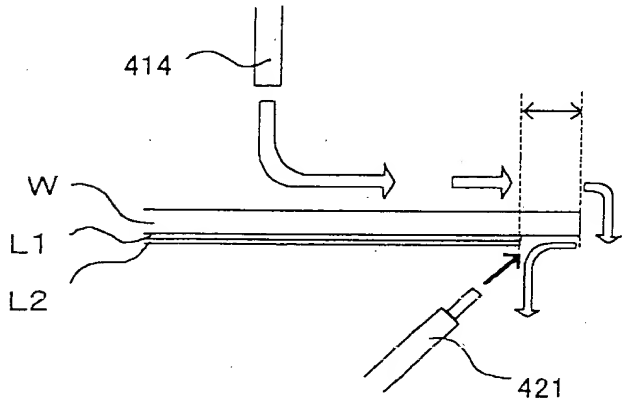
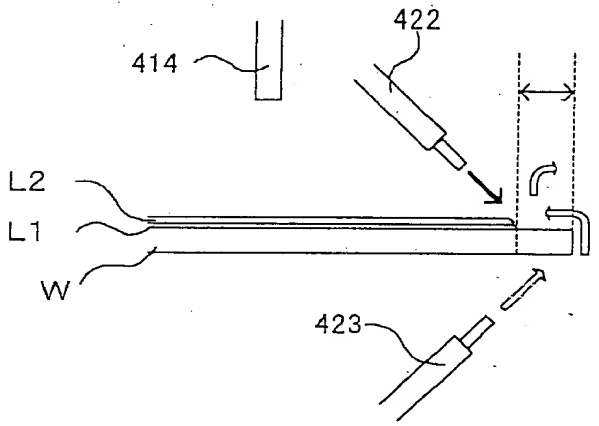
【図９】 [FIG. 9]



【図１０】 [FIG. 10]



[Name of Document] Abstract

[Abstract]

[Object] To provide a liquid processing apparatus which can process the edge of a substrate without giving an adverse influence to a device manufacture area, and which can minutely control the width of the edge to be processed.

[Solution] A chemical is splashed from a side of one surface of a substrate toward the edge of the substrate, in order to circulate the chemical to the edge of a side of the other surface. The edge of the substrate is processed by the circulated chemical, while the width of the substrate to be processed is controlled by a circulation blocking member provided at the side of the other surface of the substrate.

[Selected Drawing] FIG. 7

CERTIFIED/ADDITIONAL INFORMATION

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